CO_2 in Soil Easily Measured

Lucretia Sherrod is a biological science technician who believes that if the right lab equipment or procedure doesn't exist, you just make it yourself.

Her latest creation is a modified carbon dioxide (CO_2) analyzer. With this, she and her colleagues have developed a rapid and cost-effective way to estimate carbon decomposition rates by monitoring soil respiration. Traditional methods of measuring CO_2 levels are labor intensive and time consuming.

Soil microbes decompose plant material and release carbon for possible storage in soil. But microbes also "breathe out" carbon as CO_2. The best scenario is when more carbon is stored in soil than is lost through microbial respiration.

Sherrod transformed a single-cell infrared gas analyzer meant for monitoring CO_2 levels in greenhouses into an easy and environmentally sound way to measure soil respiration. She can run 90 samples an hour, instead of 10 to 24 per hour using traditional techniques.

After a soil sample is incubated in a chamber for 3 days, Sherrod inserts a needle through the chamber's seal and collects a sample of the atmosphere for analysis. Her system easily makes room for add-ons such as an oxygen analyzer.

Her test can measure the CO_2 produced and oxygen consumed when microorganisms eat soil organic matter. She has publicized this test with an abstract at the 2009 annual meeting of the American Society of Agronomy, the Crop Science Society of America, and the Soil Science Society of America. She is also writing a paper on the procedures. Any lab can easily build the test equipment for immediate use.—By **Don Comis,** ARS.

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Infrared Sheds Light on Beneficial Microbes

Infrared spectroscopy can quickly spot beneficial fungi on roots in soil, according to Francisco Calderon, a soil scientist at the Agricultural Research Service Central Great Plains Resources Management Research Unit in Akron, Colorado.

This type of spectroscopy has become established practice for quick and reliable analysis of grain and forage quality, as well as other agricultural uses, thanks in part to ARS scientists. But Calderon's idea to use it for detecting fungal-root associations in soils was never explored before. The ability to quickly analyze field soils for these beneficial fungi, called "mycorrhizae," would allow scientists to judge which crop rotations or other farming practices increase the fungi. This is important nationwide for improving crop yields and is especially critical for semiarid areas like those found in the Central Great Plains.

Mycorrhizal fungi live in a symbiotic relationship with plants. The fungi help plants by taking up soil nutrients and water that would otherwise be difficult for plant roots to reach. In exchange, the fungi feed on the carbon sources that plants provide.

Calderon says the test could simplify, accelerate, and improve the objectivity of measurements of mycorrhizae in root samples, compared to the standard method of visual scoring through a microscope. It may also be more accurate than the newer technique of analyzing fatty acids in mycorrhizae on roots. Also, he says, "Since there is no destruction of the samples, researchers can perform other analyses on the same samples after this test is done."

Calderon developed the technique with soil scientists Veronica Acosta-Martinez at Lubbock, Texas, and Merle Vigil at Akron. Other ARS colleagues in this study include microbiologist David Douds at Wyndmoor, Pennsylvania, and chemist James Reeves at Beltsville, Maryland.

They measured the reflectance of infrared light from dried, powdered carrot root samples. They found that the cell wall chitin and fatty acids in mycorrhizal fungi have distinct spectral signatures, absorbing infrared light at different wavelengths than standard chitin, fatty acids, and nonmycorrhizal roots. The researchers accomplished this using both mid-infrared and near-infrared spectroscopy.

Next, they plan to study the spectral properties of other crop fungal species to see whether there are universal spectral signatures for this important group of organisms.—By **Don Comis,** ARS.

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